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Editorial

Innovative Techniques for Power Consumption Saving in Telecommunication Networks

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The increase in energy cost and the need to reduce the global greenhouse gas emission to protect our environment have stimulated the investigation of new innovative techniques for the energy consumption reduction in telecommunication networks.

Some studies show that ICT is today responsible for a fraction of the world energy consumption of about 4%, and this percentage is expected to double in the next decade. ICT is expected to play a major active role in the reduction of the worldwide energy requirements, through the optimization of energy consumption.

The purpose of this special issue is to study and evaluate the impact and potential exploitation of energy-aware innovative techniques for wired and wireless networks.

The special issue consists of seven papers. The first three papers focus on the definition and evaluation of techniques, based on device clock frequency reduction and turning off of links and nodes, for the power consumption saving in wired networks. The next three papers introduce and evaluate management schemes and technological solutions for reducing the power consumption in wireless networks. Finally, the last paper investigates the use of optical technologies in reducing the power consumption of switching nodes. Brief summaries of the accepted articles are listed below.

"*Design of a traffic-aware governor for green routers*" by A. Lombardo et al. focuses on routers that achieve energy saving by applying the frequency scaling approach. The authors propose an analytical model to support designers in choosing the main configuration parameters of the Router Governor in order to meet Quality of Service requirements while maximizing energy saving gain. A case study based on the open NetFPGA Reference Router is considered to show how the proposed model can be easily applied to a real case scenario.

"*Evaluation of power saving and feasibility study of migrations solutions in a virtual router network*" by V. Eramo et al. evaluates how the migration of virtual routers can lead to an energy saving. The mechanism consists in migrating virtual routers in fewer physical nodes when the traffic decreases allowing for a power consumption saving. After formulating the problem of minimizing the power consumption as a Mixed Integer Linear Programming, a heuristic is proposed to evaluate the power saving in real network and traffic scenarios. The authors also perform a feasibility study by means of an experimental testbed to evaluate the migration time of a routing plane based on QUAGGA routing software.

"*Facing the reality: validation of energy saving mechanisms on a testbed*" by E. Tego et al. focuses on the implementation of some techniques allowing for the turning off of router interfaces. Investigations on packet lost and delay are performed by means of an experimental testbed. The authors show that it is possible to dynamically adapt the network configuration to the changing load with no impact on packet loss and little increase in packet delay.

"*Energy-aware base stations: the effect of planning, management and femto layers*" by G. Koutitas et al. investigates

algorithms and techniques that can be applied on cellular networks to provide offered traffic proportional power consumption. Three different planning strategies and Base Station management schemes are used to investigate potential energy savings in the network. Furthermore, the paper shows how the introduction of a femtocell layer can improve energy saving, Quality of Service, and coverage providing more degrees of freedom to the mobile operator to adapt the power consumption in real time.

"*Smart power management and delay reduction for target tracking in wireless sensor networks*" by J. Feng et al. proposes a smart power management scheme in Wireless Sensor Network for target tracking application. Node sleeping strategies are introduced in the surveillance and tracking stages. Experimental results show that the proposed approaches are more power efficient with respect to traditional solutions and have a better capability of extending the network lifetime while maintaining short transmission delay in target tracking sensor networks.

"*A-LNT: a wireless sensor network platform for low-power real-time voice communications*" by Y. Fu focuses on the design of a lightweight low-speed and low-power wireless sensor platform for voice communications (A-LNT). The authors discuss the key elements for energy efficient node hardware design, low-power voice codec and processing, wireless network topology, and hybrid MAC protocol design. The efficiency in power consumption of A-LNT is studied with both simulation and analytical models.

"*Hybrid optical switching for data center networks*" by M. Fiorani et al. introduces a novel data center network based on hybrid optical switching (HOS). HOS combines optical circuit, burst, and packet switching on the same network. The proposed HOS network achieves high transmission efficiency and reduces energy consumption by using two parallel optical switches: a slow and low-power consuming switch for the transmission of circuits and long bursts and a fast switch for the transmission of packets and short bursts. By means of simulation and analytical investigations, the authors demonstrate that the proposed HOS data center network achieves high performance and flexibility while considerably reducing the energy consumption of current solutions.

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